2.2.3 · Specification Limits

(a) Gain

The measured antenna gain shall be within 2 dB of the value declared in Section 1.4.

(b) Radiation Pattern

The values of the gain of the measured co-polar pattern of the antenna shall be equal to or less than the values given in Figure 2.1.

2.3 Omnidirectional Antenna

This section describes the approval test requirements method of measurement and specification limits for the omnidirectional antenna.

2.3.1 Approval Test Requirements

Approval tests will be conducted on the following antenna performance parameters:

(a) Gain

(b) Radiation Pattern

The values measured during the approval tests will meet the limits outlined in Clause 2.3.3 below.

2.3.2 Method of Measurement

Measurements shall be made at the test frequencies 57.2 GHz, 57.7 GHz and 58.2 GHz. The testing authority reserves the right "to test" at additional frequencies within the frequency band should it be deemed necessary.If the antenna is designed for use with a radome or feed shroud, then measurements shall be made with this in place.

(a) Gain

The antenna gain shall be measured using the gain-by-comparison technique in which the gain of the antenna under test is compared with that of a calibrated gain antenna, typically a standard gain horn. In practice this will involve comparing the peak received power level of the omnidirectional antenna with the peak (boresight) level received from the standard gain horn. The gain of the antenna under test is the sum of the gain of the standard gain horn and the difference in observed peak power levels (taking into account the sine of the difference) and is expressed in dBi. The particular azimuthal pointing angle of the omnidirectional antenna shall be noted. The antenna is mounted at 0° elevation. The comparison shall also be made at three other positions separated from the noted azimuth position by 90, 180 and 270 degrees. These four measurements are performed at the test frequencies. The gain is the average value of the four measurements at each frequency.

Alternative methods can be proposed, providing the testing authority is satisfied that sufficient supportive evidence as to the suitability of the method has been provided. Any alternative method of gain measurement shall be proposed to and agreed with the testing authority at least 4 weeks prior to the approval test.

(b) Radiation Pattern

The radiation pattern shall be measured on a far field test range, in the azimuth and elevation planes. The co-polar patterns are measured at the test frequencies. Azimuth patterns shall be recorded by mounting the antenna in its normal orientation (0 degree elevation) onto a single axis positioner. The antenna shall be rotated about the positioner local vertical axis between -180 and +180 degrees, and the signal level received from a fixed power output source shall be recorded as a function of angle.

Elevation patterns are measured by mounting the antenna at 90 degrees to its normal attitude and rotating about the positioner local vertical axis between -90 and +90 degrees. The received signal level shall be then recorded as a function of angle. The elevation patterns shall be measured at four different antenna azimuthal angle settings, typically spaced by 90 degrees.

2.3.3 Specification Limits

(a) Gain

The measured gain of the antenna shall be within 2dB of the value declared in Section 1.4

(b) Radiation Pattern

The measured azimuth co-polar pattern of the antenna shall be within ±3 dB of the gain measured in Clause 2.3.2..(a).

The values of the gain of the measured elevation co-polar patterns of the antenna shall be equal to or less than the values given in Figure 2.2.

Fig 2.1 Limits of Antenna Gain for Angles Greater Than 5° from the Main Beam Axis

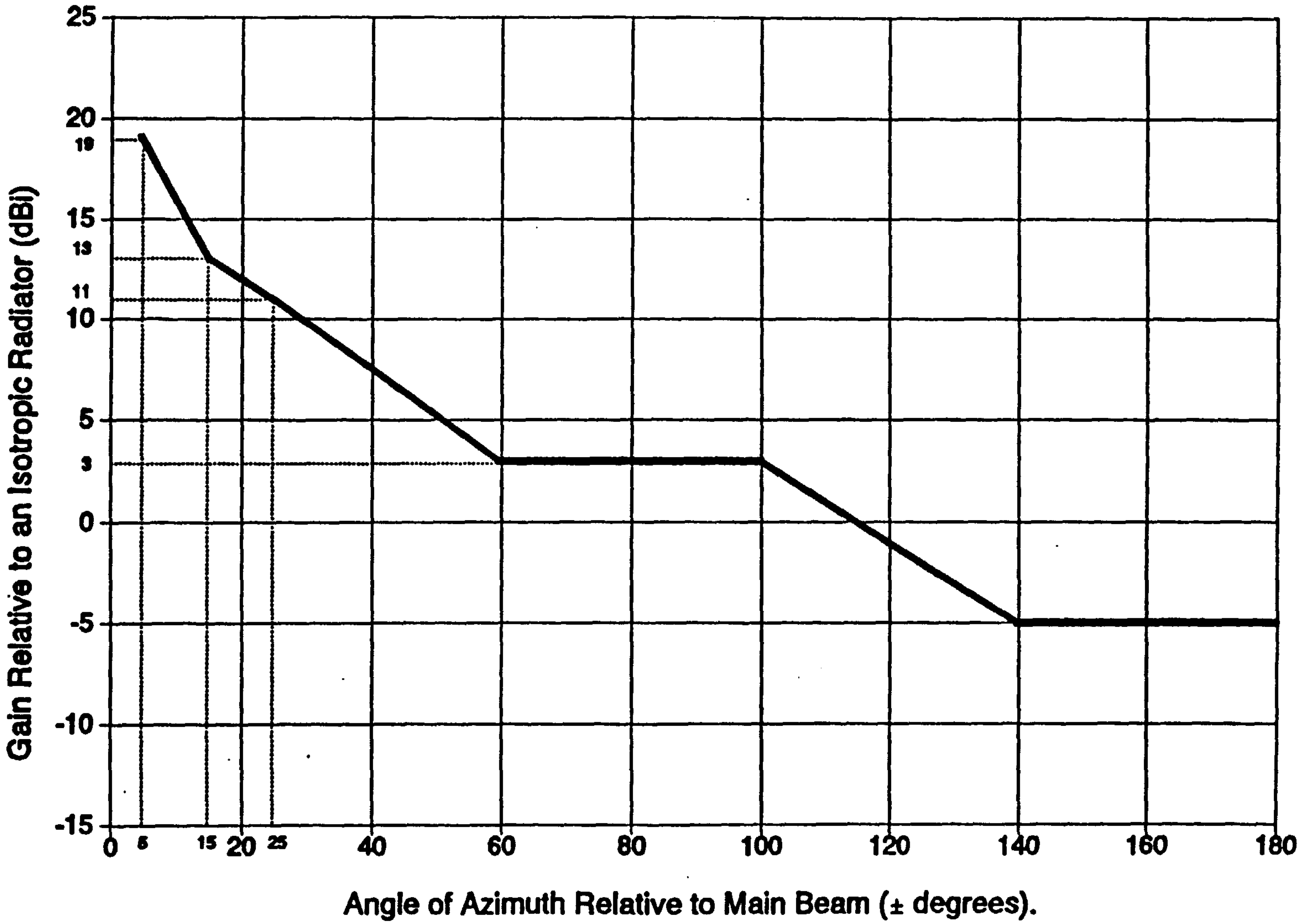


Fig 2.2 Elevation Radiation Pattern Envelope of the Omnidirectional Antenna

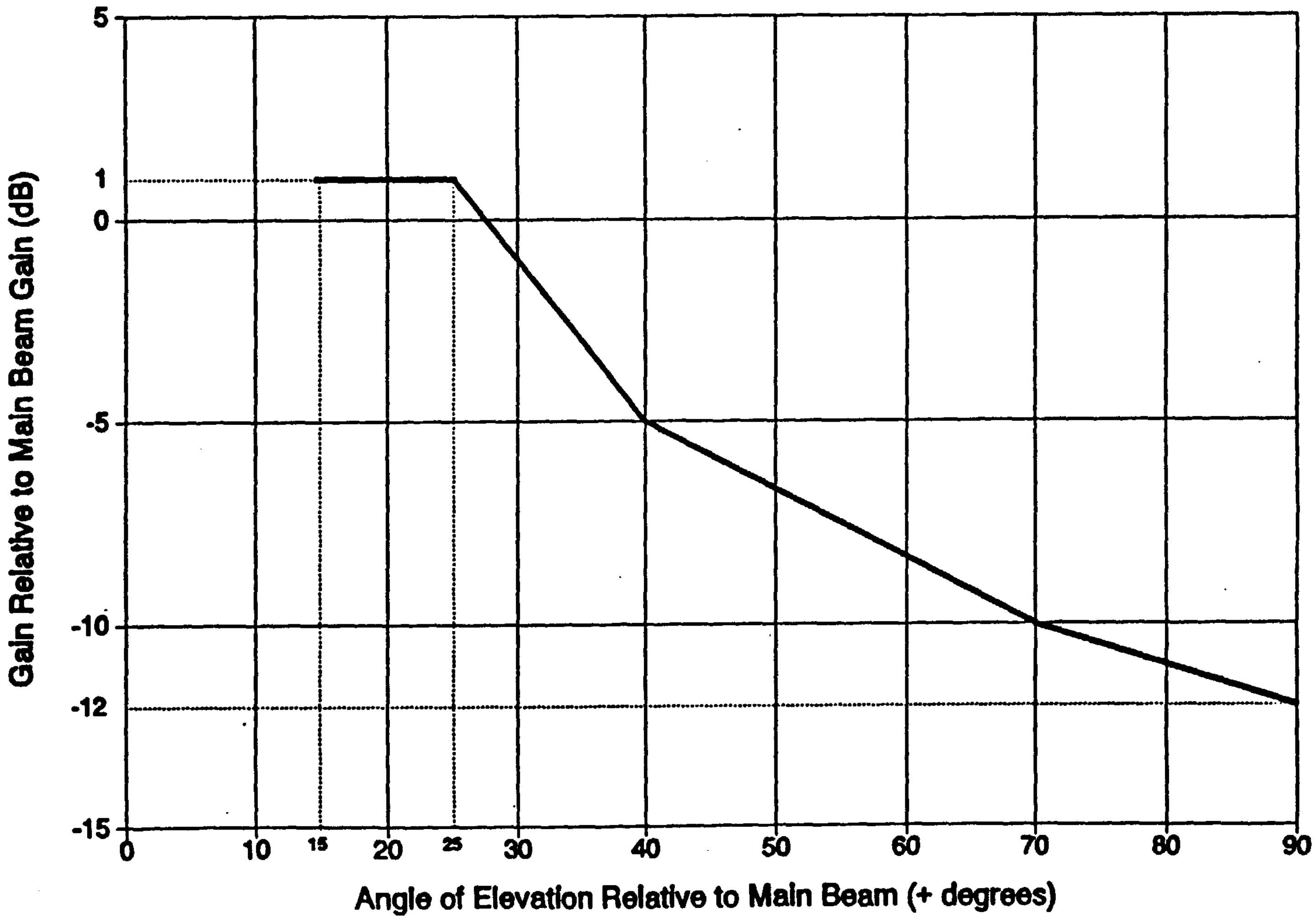


FIGURE 2.2 ELEVATION RADIATION PATTERN OF 58 GHz OMNIDIRECTIONAL ANTENNA.

PART 3

FREQUENCY BAND PLAN

For the band 57.2 to 58.2 GHz.

CONTENTS

1 CHANNEL FREQUENCIES

The band plan is comprised of 10 channels of 100 MHz each arranged as 5 pairs. Only vertically polarised transmissions are permitted at this time (see Table 1 below).

	Channel Centre Frequencies	
Channel Number	Go Frequency (GHz)	Return frequency (GHz)
1	57.25	57.75
2	57.35	57.85
3	57.45	57.95
4	57.55	58.05
5	57.65	58.15

Table 1.

2 EFFECTIVE ISOTROPIC RADIATED POWER (EIRP) LIMITS

The maximum EIRP when using a directional antenna conforming to Part 2 Fig 2.1, shall not exceed 15 dBW. The maximum EIRP using omni-directional antennas conforming to Part 2 Fig 2.2 is UNDER STUDY.

If there is a need to use an omni-directional antenna, the limit will be considered by RA on a case-by-case basis.

EX PARTE PRESENTATION

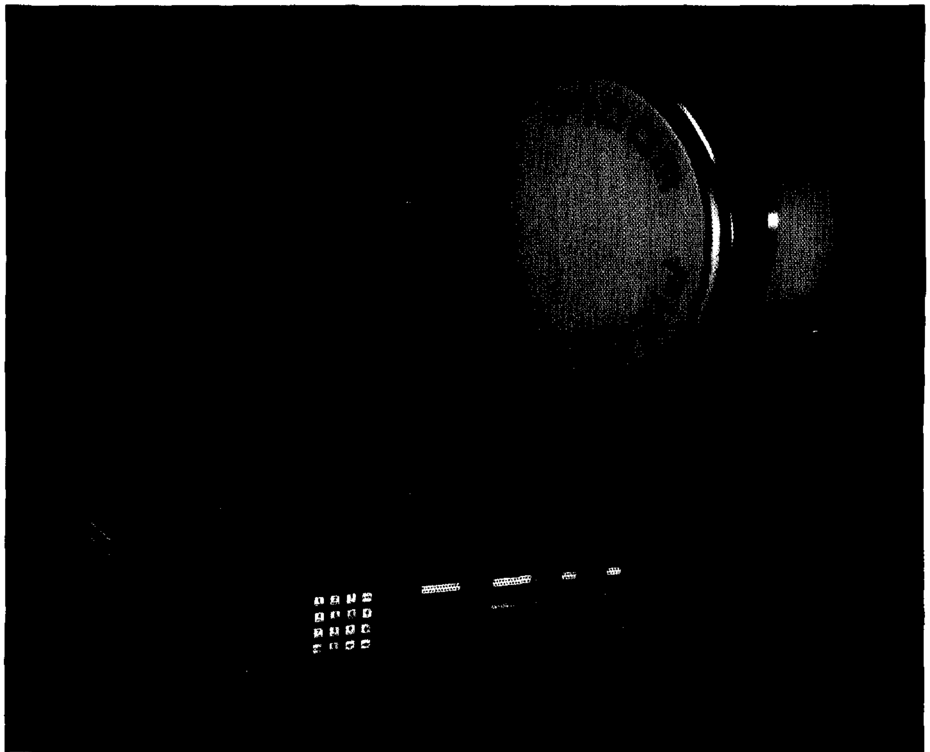
Tel-Link 50

, 2E1 & 4E1

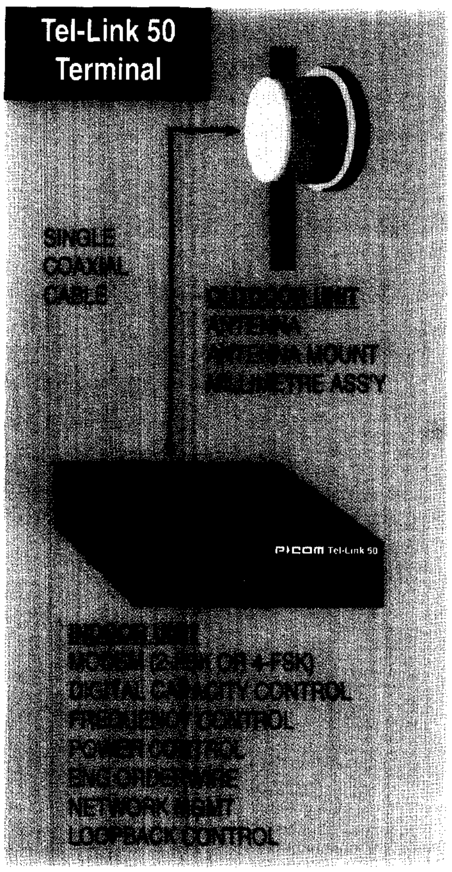
50 GHz Digital Millimetre Wave Radio System

Features

- Fully Integrated RF Electronics for Maximum Reliability and Small Size
- Indoor Unit Shelf Common to Tel-Link 23, Tel-Link 38 and Tel-Link 50 Systems
- System Capacity, Output Power and RF Frequency Changes with No Access to Outdoor Unit Required
- Advanced Forward Error Correction Enhances Performance and System Availability
- No Tuning or Adjustments Required for Simple Installation and Ease of Maintenance
- Software Controlled Capacity Upgrading from Indoor Unit
- Fully Shielded for EMC



Tel-Link 50—Digital Millimetre Wave System for Point-to-Point Communications



System Description

The Tel-Link 50 Radio System provides a cost-effective and immediate solution to voice and data transmission requirements in capacities from 2 to 8 Mb/s. Consisting of an Outdoor Unit (ODU), an Indoor Unit (IDU) and a single coaxial cable for the ODU-IDU interconnection, the Tel-Link 50 System is ideally suited for networks operated by PCN/cellular service providers, utilities, public telephone operators, local governments and private users.

The ODU consists of a light weight, compact, integrated RF electronics enclosure attached to an antenna with a diameter of 300 mm. The millimetre wave technology employed permits the complete integration of all millimetre wave functions into a single, small, rugged subassembly. This technology yields a significant increase in reliability when compared to conventional approaches. Typically, the ODU is installed outdoors on a tower or rooftop.

The IDU is an indoor mounted assembly that contains all of the baseband electronics including the functions of line interface, digital multiplexing, modulation and frequency generation. It also includes the alarm and diagnostic, service channel and network management interfaces. Furthermore, within the IDU is the capability to set the system capacity, frequency synthesiser and power output of the radio; no access to the Outdoor Unit is required. The IDU packaging allows it to exist as a stand-alone unit installed in a standard relay rack or be integrated within a customer's existing site equipment.

The advanced technology, architecture and features of P-Com's Tel-Link 50 System coupled with its cost-effectiveness provide a reliable network solution for a wide variety of voice and data transmission requirements.

Tel-Link 50 Specifications E1, 2E1 & 4E1

General

Capacities	1 x 2.048, 2 x 2.048, 4 x 2.048 Mb/s
RF Channel Spacing	E1 & 2E1 - 10 MHz, 4E1 - 20 MHz
Digital Input/Output Conn.	BNC -75 Ohm unbalanced, 120 Ohm balanced (optional)
Digital Line Code	HDB3
Modulation Type	2-FSK (4-FSK optional)
Operating Freq. Range	49.2 to 50.2 GHz
Tx-Rx Spacing	500 MHz
Tuning Range	250 MHz
Frequency Source	Synthesiser
RF Channel Selection	IDU Controlled or via NMS
System Configurations	Non-Protected (1 + 0), Protected (1 + 1)
Loopbacks	Indoor Unit, Outdoor Unit, Link

System Gain (Non-Protected)

		w/FEC	w/o FEC
10^{-6} BER	E1	92 dB	89 dB
	2E1	89 dB	86 dB
	4E1	86 dB	83 dB
		w/FEC	w/o FEC
10^{-3} BER	E1	94 dB	92 dB
	2E1	91 dB	89 dB
	4E1	88 dB	86 dB

Transmitter (Non-Protected)

Power Output	+8 dBm (6 mW)
Freq. Stability	±0.0008%
Attenuation Range	25 dB

Environmental

Temperature Range	
Outdoor Unit	-30°C to +60°C
Indoor Unit	-10°C to +55°C
Relative Humidity	
Outdoor Unit	Up to 100% (all-weather operation)
Indoor Unit	95% at +55°C
Altitude	4,500 m

Specifications reflect typical performance, are subject to change without notice, and apply to equipment connected back-to-back unless otherwise noted.

IDU - Indoor Unit
ODU - Outdoor Unit
NMS - Network Management System
FEC - Forward Error Correction

Receiver (Non-Protected)

		w/FEC	w/o FEC
Receiver Sensitivity (10^{-6} BER)	E1	-84 dBm	-81 dBm
	2E1	-81 dBm	-78 dBm
	4E1	-78 dBm	-75 dBm
Receiver Sensitivity (10^{-3} BER)	E1	-86 dBm	-84 dBm
	2E1	-83 dBm	-81 dBm
	4E1	-80 dBm	-78 dBm

Receiver Overload (10^{-6} BER)	-15 dBm
Receiver Overload (10^{-3} BER)	-13 dBm
Receiver Type	Dual Conversion
Intermed. Freq.	140 MHz
Unfaded BER	10^{-13} or better
Forward Error Correction (FEC)	Optional

Power Requirements

Standard Input	-48 VDC	
Optional Input	+24/-24 VDC	
Power Consumption (Typical)	(Non-Protected)	
	E1	40W
	2E1	40W
	4E1	45W

Mechanical

Dimensions	
Outdoor Unit	250mm dia., 200mm depth (10" dia., 8" depth)
Indoor Unit	89mm x 483mm x 267mm (3.5" x 19" x 10.5")
Weight	
Outdoor Unit	4.5 kg (10 lbs.)
Indoor Unit	3.6 kg (8 lbs.)
IDU-ODU Interconnection	
No. of Cables	1 coaxial cable
Distance	Up to 300m (1000 ft)
Rec. Cable	Belden 9913 (RG-8) or equivalent
Connector Type	"N" Male

Service Channels (Optional)

Number of Channels	Three
Capacity (each channel)	64 kb/s
Available Channel Configurations	
Engineering Orderwire	300-3400 Hz
Digital Data Channel	Up to 9600 bit/s
Network Mgmt. System	Customised
User Interfaces	
Engineering Orderwire	RJ-11
Data Channel & NMS	RS-232C, RS-422/423

Antenna

Diameter	300mm (12")
Gain	39 dBi
Beamwidth	1.6°
Polarisation	Vertical or Horizontal
Elevation Adj.	±20°-coarse, ±10°-fine
Azimuth Adj.	±180°-coarse, ±10°-fine
Std. Mounting	44mm - 114mm O.D. Pole (1.75" - 4.5")
Windloading	50 m/s (112 mph) - Operational 70 m/s (157 mph) - Survival

ISO-9001 CERTIFIED

P-COM

Other offices located in:

P-Com, Inc. — Headquarters

EX PARTE PRESENTATION

P-COM

APPLICATION GUIDE
Short Form Handbook

Tel-Link Series

23 GHz Digital Millimeter Wave Radio System
38 GHz Digital Millimeter Wave Radio System
50 GHz Digital Millimeter Wave Radio System

CEPT Rate Products

"Network Solutions For Global Wireless Communications"

P-COM Application Guide

Issue 1.4, July 1994

12/94 2,5

P-Com, Inc. - Headquarters
3175 S. Winchester Boulevard
Campbell, CA 95008
USA
TEL 408•866•3666
FAX 408•866•3655

P-Com, Inc. - United Kingdom
4200 Waterside Centre
Solihull Parkway
Birmingham B37 7YN
ENGLAND
TEL 021•717•4718
FAX 021•717•4728

P-Com, Inc. - Italy
via Lecco No. 4
20041 Agrate Brianza (MI)
ITALY
TEL 039•654509
FAX 039•650368

Notes

Table of Contents

Page

Appendix

List of Figures

Notes

Notes

Tel-Link Series of Digital Millimetre Wave Radios

1.0 Introduction

The increasing need for transmission media around the world has stimulated research and technology to develop millimetre wave radio systems in the 23, 38, and 50 GHz frequency bands. As a result, the industry has been setting standards for the use of these bands and manufacturers are now offering radio products for operation, thus, opening up new, more convenient ways of establishing transmission links. In fact, at these frequencies, radio paths carrying up to 8 Mb/s of digital information can be established with excellent performance (availability) up to 15 km in path length; the actual path length possible is primarily dependent on the frequency used, and on the rain statistics applicable to a given deployment area.

P-Com, Inc. was founded for the specific purpose of addressing the millimetre wave market with a family of radio products designed to meet the particular demand of potential users of the 23, 38, and 50 GHz bands. The proprietary technology developed and adopted by P-Com constitutes a generation leap forward in terms of reliability, performance, features, quality and, therefore, cost-of-ownership (life-cycle cost). These results have been achieved by building a selectively experienced Engineering team with talents, cultures and background particularly suitable for developing millimetre wave radio equipment. By leveraging their command of innovative technologies, the team has produced a product line of radios, the Tel-Link Series, that possesses outstanding technical and economical advantages for the end user.

Strongly motivated by the dramatic explosion of Cellular and Personal Communications Networks (PCN), where millimetre radio paths are used to interconnect Base Transceiver Stations to Base Station Controllers and further on to Switching Centres, millimetre wave radio equipment has been developed and is now being offered in the global marketplace.

This Application Guide describes the Tel-Link Series of radios, P-Com's answer to the increase in demand for millimetre wave products. These radio systems are offered in the marketplace for applications in both Public (Cellular, PCN and PTT carriers) and Private (Utilities, Pipelines, Railways, Corporations) sectors including Local Governments, and Emergency & Safety organizations. Developed and manufactured by P-Com, the Tel-Link Series of radios are the first of a comprehensive family of millimetre wave radios at frequencies that reach upward to 55 GHz and downward to 23 GHz. All radio versions of the family enjoy maximum commonalty by virtue of the proprietary architecture implemented by P-Com's Engineers whereby only the uppermost frequency components are affected by propagation frequency changes.

Notes

2.0 The Tel-Link Series of Radio's Role In Telecommunications

2.1 Service Provided

The Tel-Link Series of Millimetre Radios provide a transmission medium for digital traffic of standard capacities ranging from 2 Mb/s to 8 Mb/s (E1, 2E1, and 4E1) equivalent to 30 and 120 voice channels respectively. Tel-Link radios also contain three customer service channels: an engineering orderwire, a general purpose digital data channel and a network management channel. These radio links may be established between any two points in line-of-sight. Depending on the geographic region and its rain statistics the link distance can range from 5 km to 15 km; 23 GHz to 15 km, 38 GHz to 10 km, or 55 GHz to 5 km.

2.2 Network Applications

The major application areas for P-Com's Tel-Link Series of Radios are the following:

a) Personal Communications, Cellular and Microcellular Networks

- Cellular to Microcellular expansion/migration (see Figure 2.1).
- Base Transceiver Station (BTS) to Base Station Controller (BSC) (see Figure 2.2).
- BSC to Mobile Switching Centre (MSC) (see Figure 2.2)

b) New Public Telecommunications Operator (PTO) Line Expansion (see Figures 2.3 & 2.4)

- Reaching new domestic/business settlements from a Point-of-Presence.
- Alternative to copper/fibre optics in urban areas.
- Saving investments in equivalent cable solutions (developing countries).
- Saving time to bring telecom services where needed (Eastern Europe).

c) Utilities Telecom Services (see Figure 2.5)

- Power Utilities needing to reach outposts.
- Pipelines for surveillance and management of remote sites.
- Railways for signalling and service traffic distribution.

d) Campus Telecom Environment (see Figure 2.6)

- Corporations
- Financial Institutions/Private Businesses
- Universities
- Local Governments

Figure 2.1 – Cellular/Microcellular Application

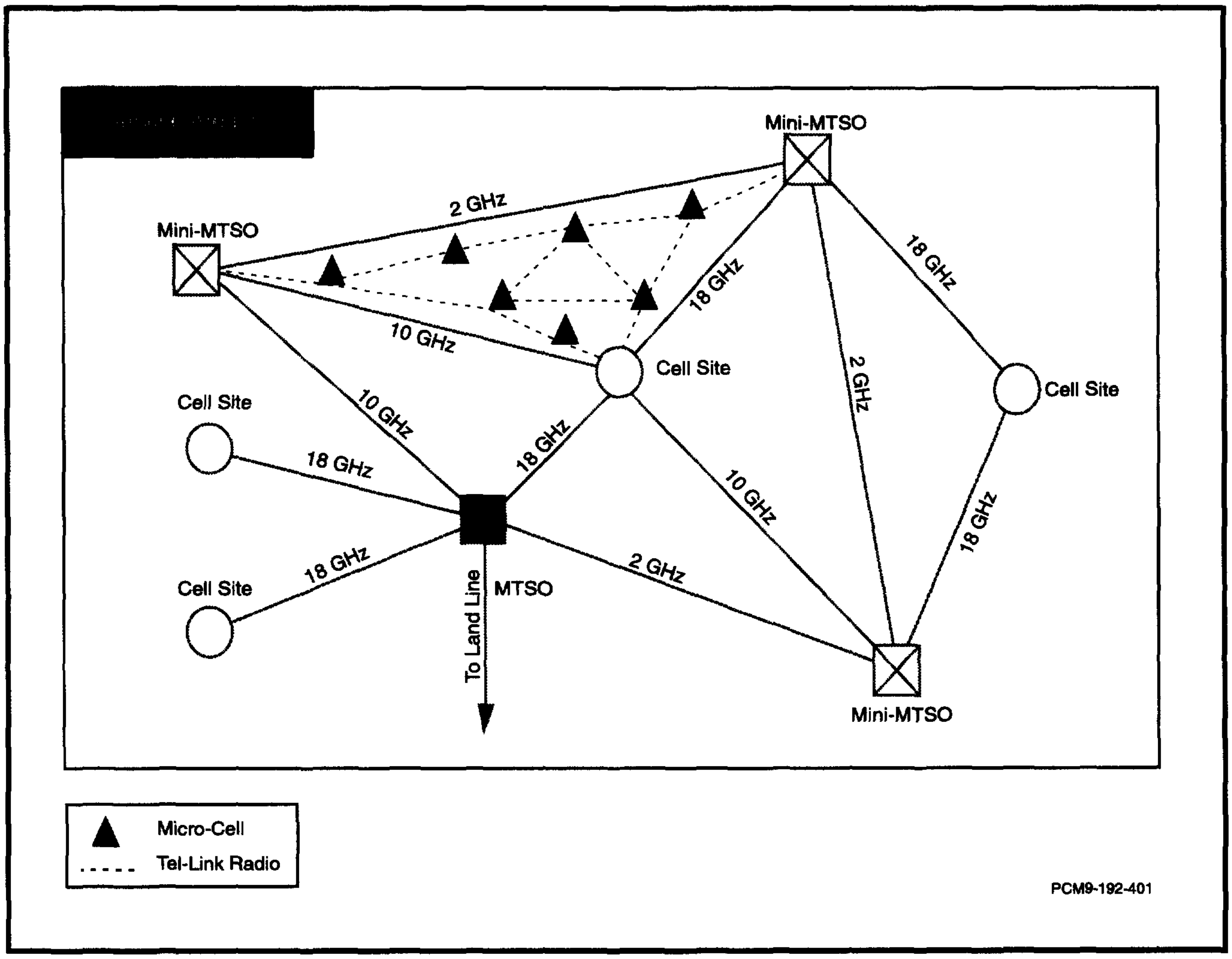


Figure 2.2 – Personal Communications Network (PCN) Application

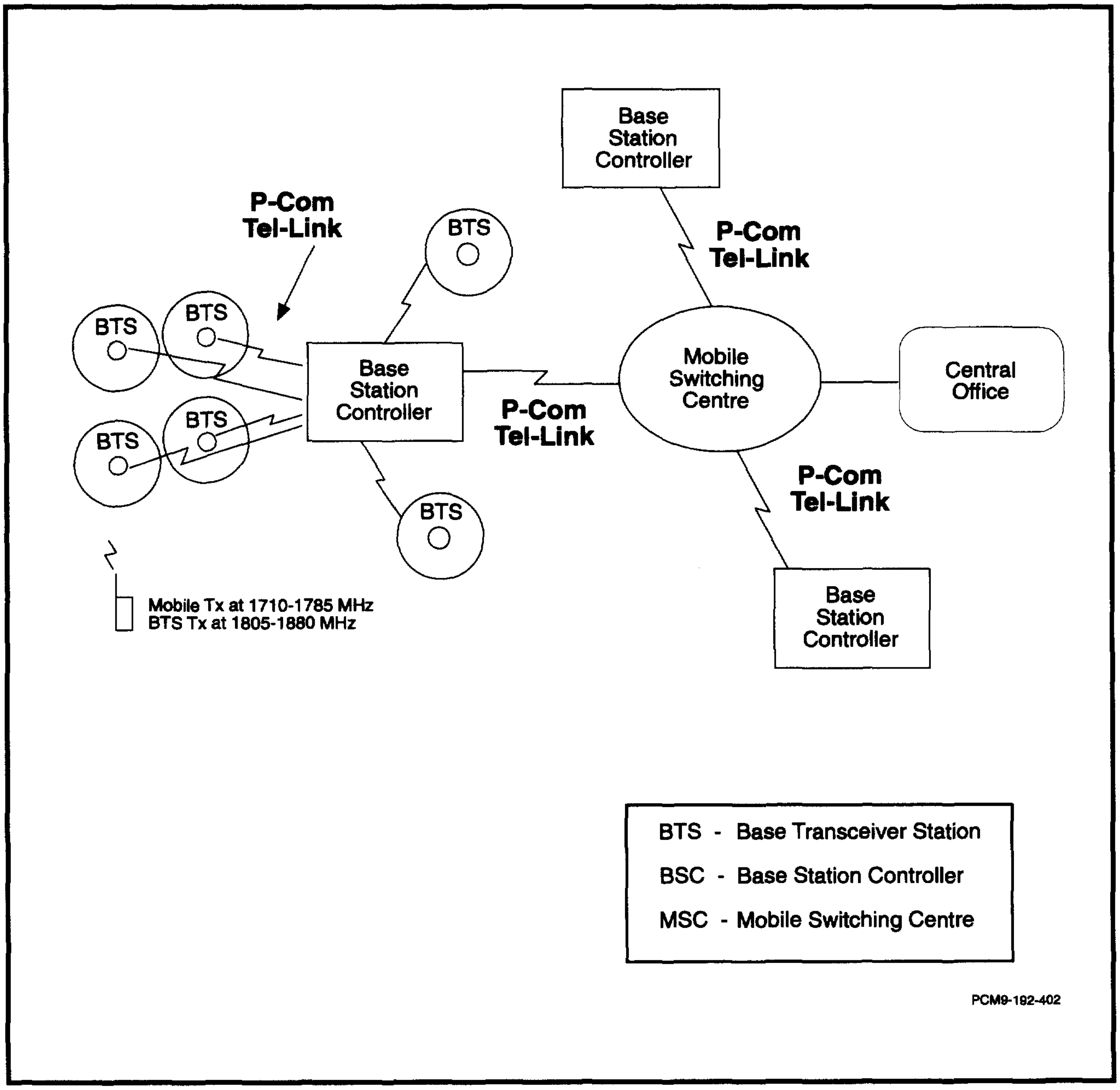
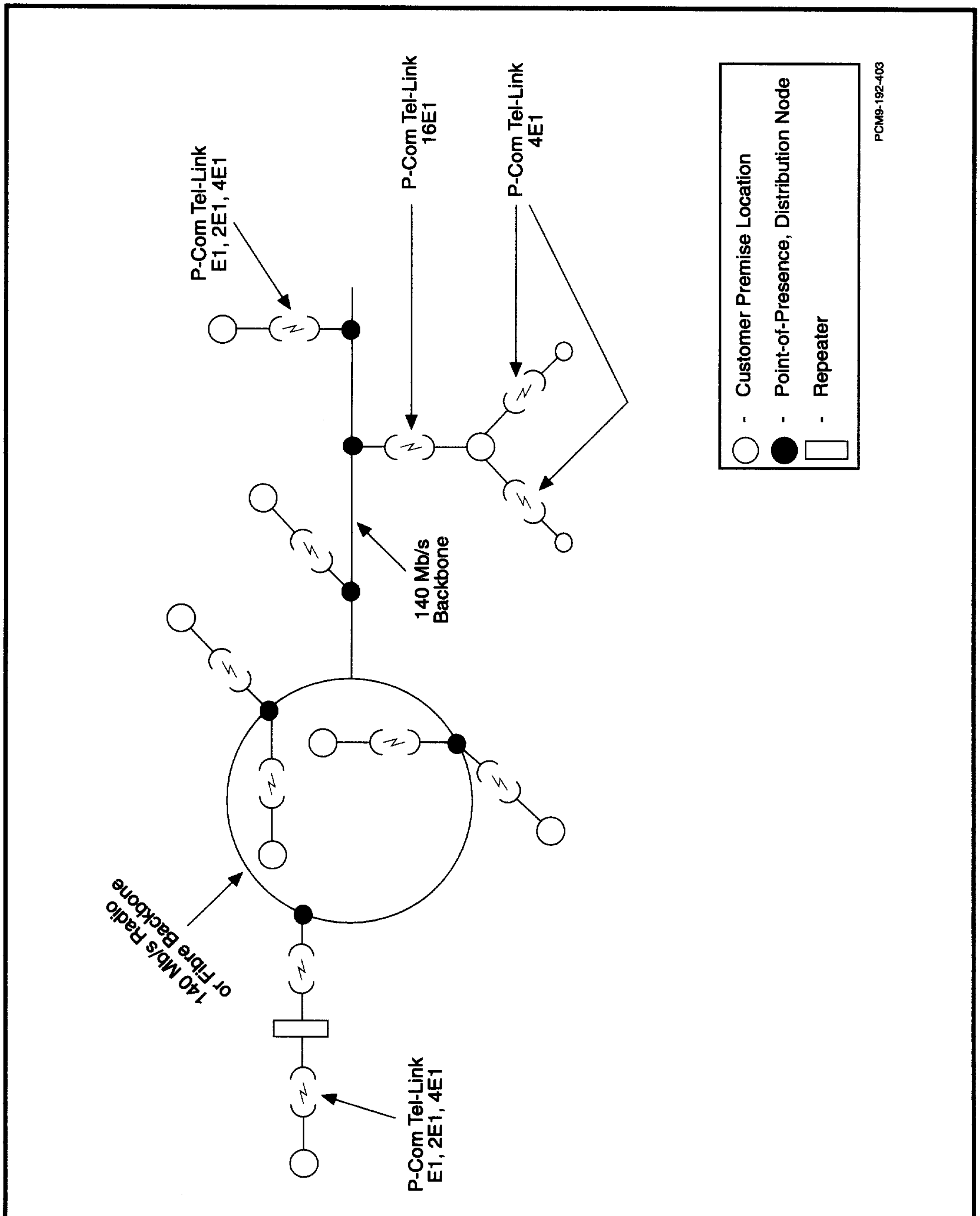


Figure 2.3 – Public Telecom Operator Application



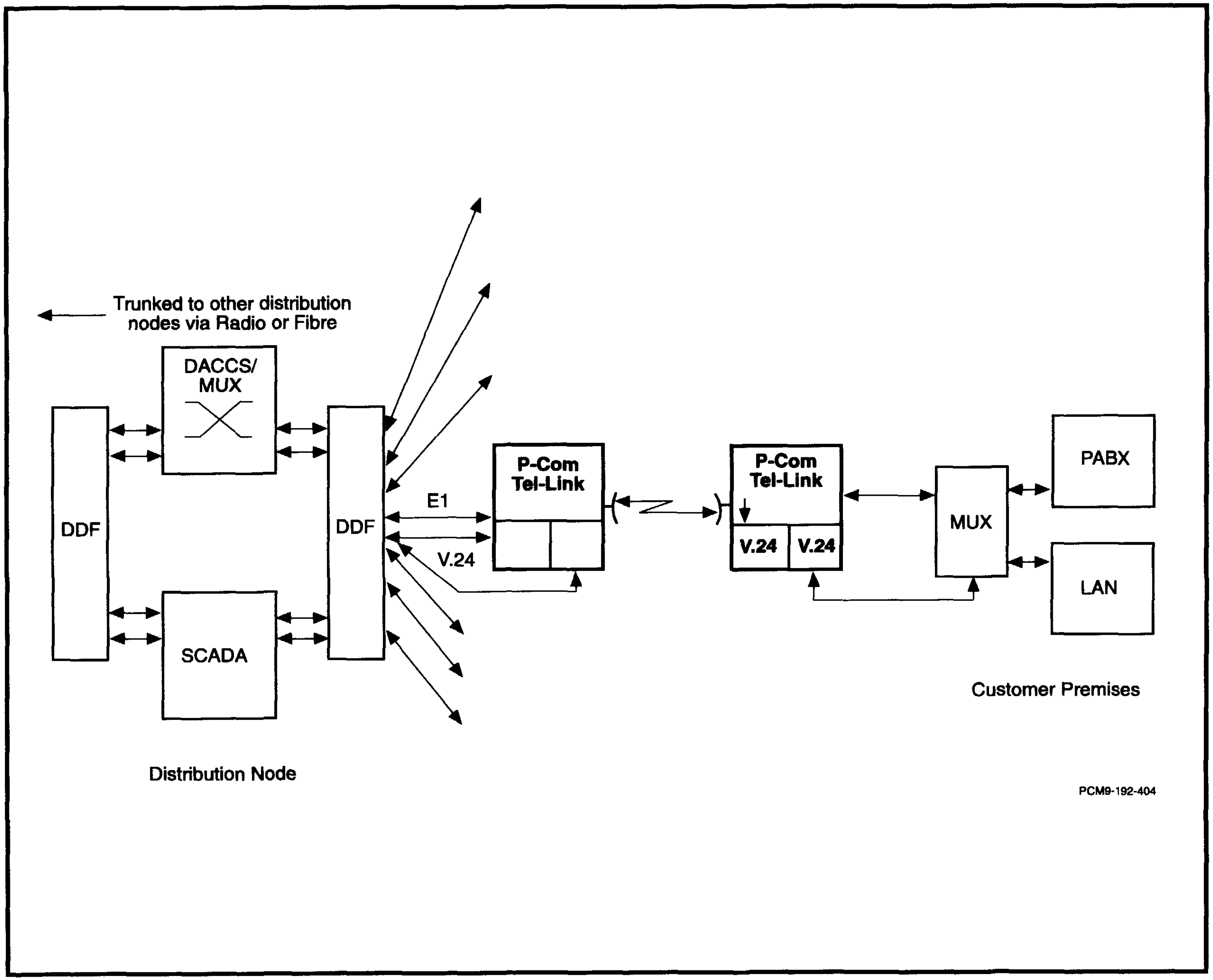


Figure 2.4 – Public Telecom Operator Application

Figure 2.5 – Utilities Telecom Services Application

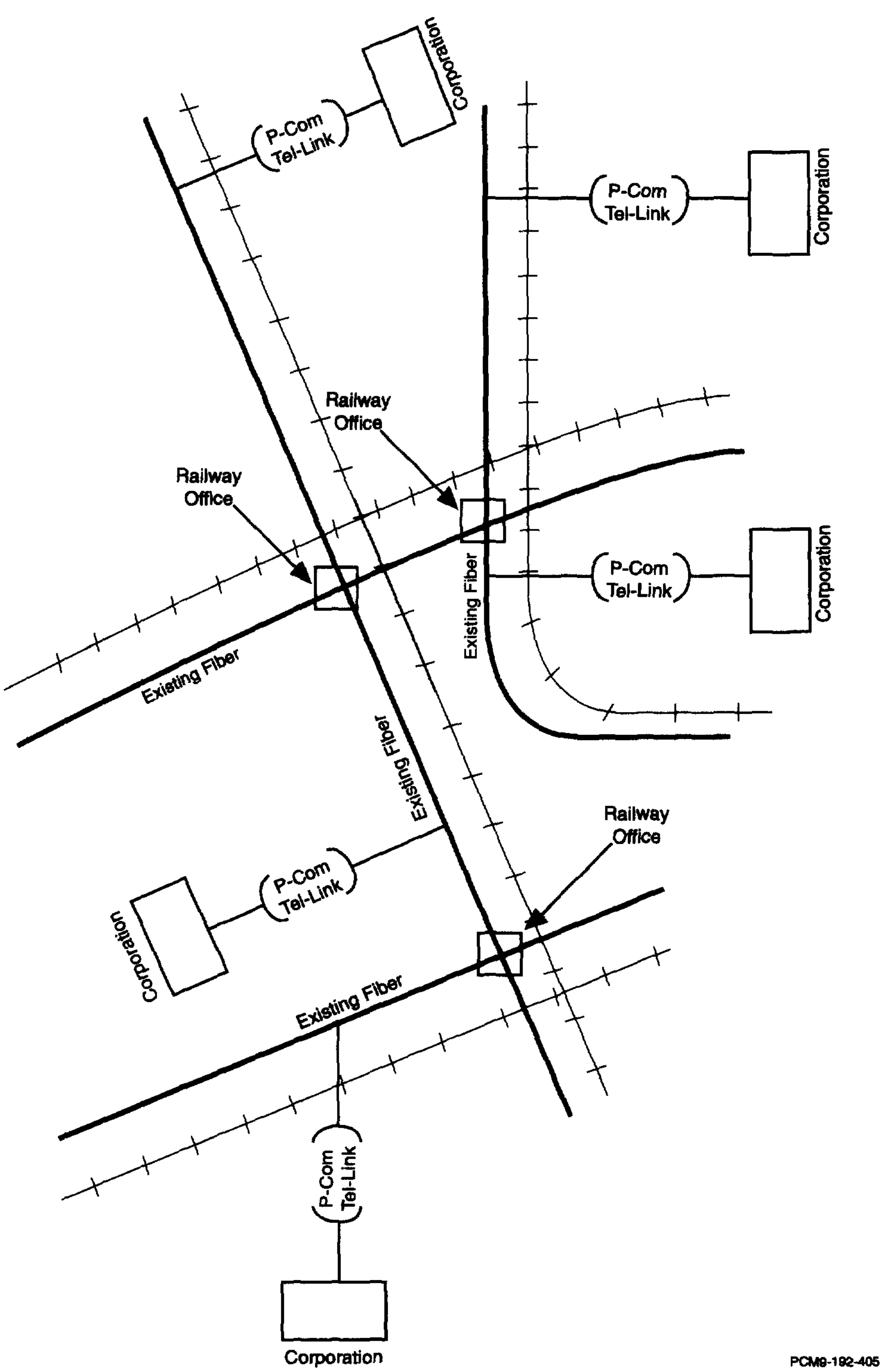


Figure 2.6 – Campus Telecom Environment Application